

1  
AS 84 Mr  
c.4

Stb

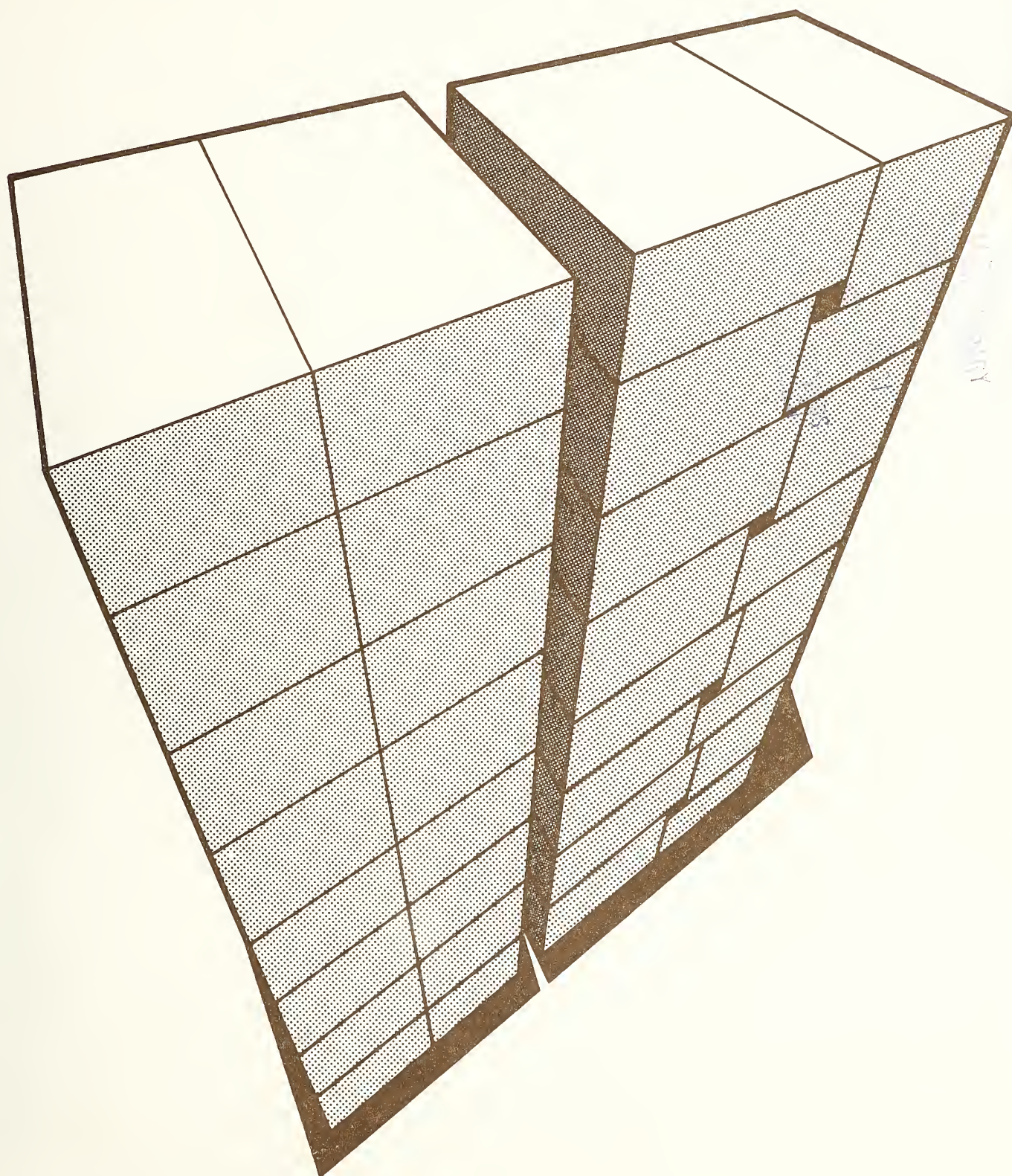


United States  
Department of  
Agriculture

Agricultural  
Marketing  
Service

Marketing  
Research Report  
Number 1121

# Evaluation of Slipsheets for Unitized Shipment of Groceries in Trailers





## Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.



# Evaluation of Slipsheets for Unitized Shipment of Groceries in Trailers

By John C. Bouma and Paul F. Shaffer<sup>1</sup>

---

<sup>1</sup>John C. Bouma is a marketing specialist with Market Research and Development Division, Agricultural Marketing Service, Beltsville, Md. 20705. Paul F. Shaffer is president of Paul F. Shaffer Co., Miami, Fla. 33156.

Preface

This study is part of a continuing research program of the Agricultural Marketing Service, designed to find more efficient and less costly methods for handling agricultural products from producer to consumer. It was conducted under contract by the Paul F. Shaffer Co., management consultants, Miami, Fla.

Appreciation is extended to the suppliers, trucking companies, and wholesale-retail distribution companies for use of their facilities to measure productivity in plant handling and loading and unloading trucks by various methods.

Single free copies of the report are available upon request to the Market Research and Development Division, Agricultural Marketing Service, U.S. Department of Agriculture, Beltsville, Md. 20705.

Contents

	<i>Page</i>
<b>Summary</b> .....	5
<b>Introduction</b> .....	6
<b>Objectives and methodology</b> .....	7
<b>Slipsheet handling</b> .....	8
Supplier plant handling .....	8
Loading trailers .....	9
Unloading at the distribution warehouse .....	9
Slipsheet shipping cost .....	9
<b>Pallet and handstack shipment</b> .....	10
<b>Comparison of truck shipping systems</b> .....	11
Total systems cost .....	11
Warehouse unloading costs .....	13
<b>Observations</b> .....	14
<b>Appendix</b> .....	16

## Summary

The greatest progress in achieving cost reduction in the food industry has been when firms concerned with total distribution cooperate on improved methods. The development of the Universal Product Code is the classic example of a cooperative effort in improved methods.

The use of slipsheets for unitized shipment of grocery products by truck is another total system problem in distribution that requires an understanding of problems and opportunities by all grocery handlers. Potential benefits are available to the supplier, carrier, and food distribution warehouse with slipsheet shipment, but such a program cannot be implemented without cooperative effort.

Some savings potential is lost when the supplier ships on slipsheets and the warehouse does not have the equipment for unloading. Many warehouse managers are reluctant to purchase the necessary unloading equipment until there are more slipsheet loads. The trucker, who is caught in the middle, will continue to move the product as required by the shipper even though unitized loading and unloading saves time.

The potential savings for slipsheet shipment, with clamp loading, is \$48.13 per load when compared to handstacked loading and unloading, and \$45.17 when compared to pallet shipment. Based on savings of \$45.17 per trailerload, industry savings of more than \$160 million annually can be achieved in the marketing system with unitized slipsheet shipments of groceries. Additional savings can be achieved by individual case film wrapping and unit loading on slipsheets. This results in reduced damage in shipment and reduced labor costs in shelf-stocking in retail stores.

Slipsheet shipment will reduce total distribution costs. However, implementation of the slipsheet system has been slow because some warehouse managers recognize they incur additional costs when unloading slipsheeted trailers. These costs include a lift truck with push-pull attachment that they feel must be operated by warehouse personnel whereas handstacked loads are most often palletized and moved to the dock with a palletjack by carrier personnel. The cost for warehouse dock personnel, equipment, and space total \$7.99 for palletjack by carrier personnel. The cost for warehouse dock personnel, equipment, and space total \$7.99 for palletized product, \$10.95 for handstacked, and \$12.11 for slipsheeted. The added costs per load for slipsheet unloading, \$4.12 when compared with pallets and \$1.16 when compared with handstacked, are the concern of receiving warehouse managers even though slipsheet shipment provides total system savings. One step that can be used to encourage more unitized shipment of groceries on slipsheets is to transfer part of the unloading allowance, now included in the tariff, from the carrier to the warehouse receiver who will unload the trailer.

## Introduction

An estimated 70 percent<sup>2</sup> of the grocery receipts arrive at the food distribution warehouse by truck. While the volume of receipts at the truck dock has grown, productivity has lagged behind that experienced at the rail dock. Unitized shipment on pallets in railcars replaced handstacked shipment when pallet-exchange programs and free return of empty pallets made this system less costly. Now unitized shipment on slipsheets is replacing pallets in railcars because of the mounting cost of pallet repairs and pallet-exchange problems.

Pallet shipment in trucks, other than backhaul on the firm's own trucks, has not grown appreciably because of the loss of payload to the driver and the return or exchange problem. Slipsheet shipment in trailers is a relatively new development and accounts for a small percentage of truck shipments.

The deterrents to slipsheet shipment on trailers include the following: (1) Few grocery warehouses have forklift trucks with a push-pull attachment<sup>3</sup> for unloading slipsheet unit loads assigned to the grocery docks; (2) the masts of push-pull forklift trucks used at the rail dock may be too high to enter some trailers; (3) push-pull forklifts may be too heavy for some of the trailers; (4) relatively few grocery trailers are loaded with slipsheet unit loads; and (5) a lack of incentive for wholesale distribution warehouses to use warehouse personnel to unload trucks when this function is usually performed by the carrier.

Two factors are now providing impetus to grocery slipsheet shipment: availability of smaller forklift trucks having a push-pull attachment that can enter virtually all over-the-road trailers and the increased cost to the suppliers of maintaining pallets. Pallet-exchange pro-

grams have not operated satisfactorily for truck shipment. In addition, pallets occupy up to 10 percent of the cubic space in the load and reduce payload by 3 percent or more, so it is logical to look for lower cost shipping platforms.

In a previous study, handstacked and unitized grocery loads were studied from loading at the supplier plant to unloading at the food warehouse for both railcar and truck shipment.<sup>4</sup> Although slipsheet shipment in trucks was included in the study, the results were not statistically reliable because of the limited number of studies. The growth of truck shipment, the availability of improved unloading equipment, and the increased cost of pallet shipment make it highly desirable to further explore the economic feasibility of slipsheet grocery shipment in trailers.

<sup>2</sup>Bouma, J. C. Truck unloading of manufacturers shipments at grocery distribution warehouses. ARS-NE-68, U.S. Dept. Agr., 1976, 23 pp.

<sup>3</sup>The push-pull attachment engages the tab of the slipsheet, pulls the unit load, including the slipsheet, onto the tines of the forklift, and then pushes the unit load onto the floor of the trailer in loading or onto a pallet in unloading.

<sup>4</sup>Bouma, J. C. and P. F. Shaffer. Systems for handling grocery products from supplier to distribution warehouse, MRR-1075, U.S. Dept. Agr., 1978, 44 pp.

## Objectives and Methodology

The first objective of this study was to measure the cost of slipsheet shipment and compare the results with conventional shipment by handstacking and pallet loading and unloading. A second objective was to determine the most efficient method of loading and unloading trailers using slipsheets as unit loads. For example, should the product be placed on slipsheets with a clamp-lift truck (a forklift truck with an attachment to pick up and transport unit loads with squeeze-type pressure plates), or should the product be on slipsheets and loaded into the trailer with a forklift having a push-pull attachment?

Time and cost standards were developed in two supplier plants for loading trailers, one using the slipsheet attachment and the other using the clamp attachment, and in two wholesale food warehouses on trailer unloading that received five or more trailerloads on slipsheets daily for more than 1 year.

The labor studies for loading include all activities from the supplier plant-dock staging area to the completion of loading and include labor to secure either the unit load or the total trailerload. The truck driver's time is excluded from all loading operations except for time actually spent on loading activities. The unloading labor studies include all activities from opening the trailer door until the unit loads are placed in the temporary holding area on the dock. They include the handling of dunnage, damaged product, and the placing of inventory tags on the palletized unit loads prior to storage. The truck driver's time during unloading is included for all unloading methods. However, time is excluded in the unloading studies for special handling such as removal of one or more layers of cases from the unit load so the product will fit in pallet racks and when the unit load contains more than one item that must be placed on separate pallets. While such handling is frequently encountered in unloading, it was necessary to eliminate it in this study in order to provide valid unloading standards. A personal and fatigue allowance of 15 percent was added for all personnel studied. A labor cost rate of \$8.40 per hour, including fringe benefits, is used for all labor. The loading and unloading studies for pallet and handstack shipment of grocery products, as reported in MRR-1075 (see footnote 4), were updated to reflect increased labor and equipment costs.

Tariff schedules for truck shipment were analyzed to determine any difference in transportation costs for the three methods of shipment. All studies were adjusted to reflect an average trailerload of 1,320 cases, 66 cases per unit load, and 20 unit loads for unitized shipment. This allowed the comparison of the different methods without distortions caused by different case sizes and weight.

## Slipsheet Handling

With slipsheet handling the transfer of a palletless unit from supplier storage to the carrier, and from the carrier onto a warehouse pallet, is accomplished. The slipsheet is typically 44 by 52 inches so that a 4-inch lip extends from two sides of the 48- by 40-inch unit load.

Unitized loads on slipsheets permit better utilization of cubic space and reduced weight in the carrier. If all grocery products were shipped on slipsheets, the average trailer capacity would be approximately 10 per cent greater than with pallet shipments.

There are two methods of loading slipsheets onto the carrier. When the supplier has palletless storage and product handling, a forklift truck with a clamp attachment (fig. 1) engages the unit load and transports it to the carrier.

The unit load is placed on a slipsheet that was previously placed on the trailer floor. When the supplier stores product on pallets, the slipsheet is placed on the pallet under the unit load during palletization at the end of the packaging line. At the loading dock a forklift truck with a slipsheet attachment (fig. 2) engages a lip of the slipsheet and pulls it onto the platen of the forklift truck. The unit load is then transported into the trailer and is pushed onto the floor.

### Supplier Plant Handling

There are advantages to the supplier with use of palletless storage and handling because it provides greater flexibility for different methods of grocery shipment. Palletless handling can be used equally well to position unit loads on the floor of the trailer for hand-stack loading, on slipsheets previously laid on the floor, and on pallets.

The clamp-forklift truck is used in palletless handling and can better adjust to the unit-load sizes requested by customers. Clamp-forklift truck handling and palletless storage have cost advantages over pallet handling and storage. In a previous study, pallet and palletless storage in the supplier plant were evaluated.<sup>5</sup> The cost of storage was 61 percent higher with pallet—\$35.17 per load—compared with \$21.89 for palletless storage (table 1).



Figure 1.—Forklift truck with a clamp attachment used to transport unit loads from storage into trailer.



Figure 2.—Forklift with push-pull attachment removing a slipsheet unit load from a pallet.

Table 1.—Supplier plant-storage costs with use of pallets and palletless storage

Cost item	Type of storage	
	Pallet	Palletless
	<i>Dollars per 1,320, case load</i>	
Storage space <sup>1</sup>	27.47	21.89
Pallet racks <sup>2</sup>	7.70	—
	35.17	21.89

<sup>1</sup>Based on annual space rental at \$1.75 per square foot, 85.6 square foot pallet bay, annual case storage at 10 stock turns of 7,200 cases. Palletless storage based on 166.75 square foot bay and 17,600 case annual storage.

<sup>2</sup>Based on installed rack cost of \$415, annual cost of \$42 including interest and depreciation, divided by 7,200 annual case storage times 1,320 cases.

<sup>5</sup>Bouma, J. C. and P. F. Shaffer, Feasibility of using a second unit load size for distributing groceries from supplier to distribution warehouse. AAT-NE-2, U.S. Dept. Agr., 1979, 20 pp.



Figure 3.—A forklift truck, with a push-pull attachment, placing a slipsheet unit load on the top pallet.

Table 2.—Production standards for slipsheet unit-loading trailers with forklift trucks having push-pull attachments and clamp attachments<sup>1</sup>

Standard <sup>2</sup>	Method of loading	
	Slipsheet attachment	Clamp attachment
Worker-minute per case	0.042	0.037
Worker-minute per load	55.2	49.1
Cases per worker-hour	1,435	1,613
Dollar labor cost per load <sup>3</sup>	7.73	6.87

<sup>1</sup>20-unit loads, 66 cases per unit load, and 1,320 cases per trailer.

<sup>2</sup>Appendix tables 4 and 5 provide detailed elemental times for slipsheet loading.

<sup>3</sup>Based on labor cost of \$8.40 per hour.

### Loading Trailers

The composite loading production standards developed in this study are shown in appendix tables 4 and 5. The clamp-loading method was 12 percent more productive in terms of cases per worker-hour<sup>6</sup> than the slipsheet method using a push-pull attachment (table 2).

### Unloading at the Distribution Warehouse

Trailers loaded with slipsheets are the same whether loaded by clamp or the slipsheet attachment. The grocery distribution warehouses only have forklift trucks with the slipsheet attachment. It is possible to load with the clamp, but virtually impossible to use it for unloading because of load shifting in transit. In unloading, the forklift operator will either engage the tab of the slipsheet and pull the unit load onto the platen or chisel under the slipsheet and pick up the unit load. The slipsheet unit load is transported to the dock where it is aligned and positioned on the top pallet of a stack (fig. 3).

The unit load is then pushed onto the pallet, the forklift-truck operator engages the pallet, checks and tags the unit load, and moves it to the dock staging area for later storage by a conventional forklift truck.

The truck driver's time during unloading is included in the labor standard because the driver accompanies the truck and either participates in the unloading or waits until the vehicle is unloaded. Usually, the driver removes any taping or other dunnage, assists in engaging difficult slipsheet tabs, and, where necessary, removes layers or repalletizes unit loads. Productivity in unloading was 617 cases per worker-hour, and labor cost was \$17.96 per load based on a standard of 0.0972 worker-minute per case (appendix table 6).

### Slipsheet Shipping Cost

The only differences in the shipping cost, excluding vehicle costs, for the two systems of slipsheet shipment, are the labor cost for loading (\$0.86 per load higher for loading with the push-pull attachment), and the equipment cost for loading (\$0.12 per load higher for the push-pull attachment method). (See table 3.) The measured shipping cost per load was \$53.91 for slipsheets when loaded with a forklift having a push-pull attachment, and \$52.93 with the clamp attachment.

<sup>6</sup>The terms "worker-hour" and "worker-minute" are substituted throughout this report for the terms "man-hour" and "man-minute" previously used in USDA reports. The terms have identical meanings to those defined for "man-hour" and "man-minute" in the American National Standard-Industrial Engineering Terminology publication ANSI-Z94.12-1972.

## Pallet and Handstack Shipment

**Table 3.—Labor, equipment, materials, damage, and dunnage cost for shipping groceries on slipsheets loaded by clamp and push-pull forklift equipment**

Cost item		Method <sup>1</sup>	
		Push-pull attachment	Clamp attachment
		Dollars	Dollars
Labor:	Loading	7.73	6.87
	Unloading	17.96	17.96
Total labor		25.69	24.83
Equipment:	Loading	1.06	.94
	Unloading	2.48	2.48
Total equipment		3.54	3.42
Materials <sup>2</sup>		10.00	10.00
Damage <sup>3</sup>		11.08	11.08
Dunnage <sup>4</sup>		3.60	3.60
Total cost per load		53.91	52.93

<sup>1</sup>The method applies to loading only. All slipsheet loads are unloaded using forklift trucks with push-pull attachments.

<sup>2</sup>Based on 20 slipsheets at a cost of \$0.50 each.

<sup>3</sup>Based on average damage of one case at \$11.08 per case.

<sup>4</sup>Based on two bands of tape on each unit load at \$0.18 or \$3.60 per trailerload.

**Table 4.—Labor, equipment, materials, damage, and dunnage cost for shipping groceries from supplier to distribution warehouse palletized and handstacked in trailers<sup>1</sup>**

Cost item		Pallet	Handstacked
		Dollars	Dollars
Labor:	Loading	4.96	26.18
	Unloading	9.69	46.16
Total labor		14.65	72.34
Equipment:	Loading	1.24	4.52
	Unloading	1.22	4.38
Total equipment		2.46	8.90
Materials		25.80	N.A.
Damage		8.31	6.54
Dunnage		3.60	N.A.
Total cost per load		54.82	87.78

N.A. = not applicable

<sup>1</sup>For additional cost details, see appendix table 1.

Loading trailers with unit loads on pallets was a one-person operation in the firms which participated in the previous study. (See footnote 4.) Product was transported on pallets by forklift trucks. The only dunnage on palletized trailer shipments was the placing of tape on the top layer of cases to reduce load shifting as was done in shipping product on slipsheets. At the grocery distribution warehouse the forklift-truck operator removed the pallets, checked the product, applied an inventory tag, and moved the pallet to storage. The driver would assist when needed, such as in removing tape and repalletizing cases. For unloading, the truck driver's time is included from arrival at the dock until unloading is completed.

In the two participating supplier firms, methods differed in loading trailers for handstack shipment. The participating supplier firms used both pallet and palletless storage. In one firm pallet loads of product were moved into the trailer for handstack loading with an electric palletjack or a forklift truck. In the other firm a forklift truck with clamp was used to move unit loads into the trailer for handstacking or was positioned in place and product handstacked around it. Clamp loads positioned in place were not included in the time standards for handstack loads. At the distribution warehouse the driver and/or helper stacked cases on pallets, and either the driver moved the pallet load to the dock or the forklift operator would enter the trailer and remove the palletized unit load. The latter method, where the warehouse forklift operator removed unit loads from trailers, was used for comparison with other unloading systems. As shown in table 4, the total cost was \$87.78 per load for handstack shipment and \$54.82 for palletized shipment. The most significant cost element for handstack shipment is labor.

## Comparison of Truck Shipping Systems

Costs for the three methods of grocery shipment by truck depend on factors included in the analysis. When the labor, materials, equipment, damage, and dunnage costs from the supplier's plant staging area to the wholesale distribution warehouse staging area on the dock are compared, there is little difference in cost between pallet and either type of slipsheet shipment.

### Total Systems Cost

With a total systems approach, other relevant costs such as supplier storage costs and transportation costs need to be included. In the supplier plant the cost of storage is higher for pallet storage because pallet racks are needed to utilize the cubic space. In comparison to palletless storage and clamp loading, storage costs are \$13.28 more per 1,320-case load with use of pallets and slipsheet shipment and the push-pull forklift truck. This cost will also apply to an indeterminate percentage of handstacked loads.

There are marginal unit-load platform costs in the wholesale distribution warehouse which should be mentioned. While the slipsheet unit provides product protection from damaged pallet decks and protruding nails, it also adds handling cost. Assembling and salvaging slipsheets by warehouse personnel are intermittent labor operations and are difficult to measure. In this study it is assumed that the labor to assemble the used slipsheets is offset by their salvage value. If the market value for used paper is \$48 per ton and the slipsheet weighs 2.5 pounds, the salvage value of each slipsheet is 6 cents, less the cost of handling.

A pallet-loaded trailer will typically carry 20 pallets which weigh approximately 1,500 pounds. With a tariff of \$2 per hundredweight, the potential added cost for pallet shipment is \$30 per load, assuming the trailer is loaded to the weight limit. The cost may be even greater when fewer cases can be hauled because pallets reduce the available cubic space. Included in the previous study (see footnote 4) were 13 trailerloads with light or bulky items that were shipped on pallets. The average load was 30,500 pounds and 875 cases. Freight cost at \$2 per hundredweight would average \$610. If, by the elimination of pallets, the available cubic space could be increased by 10 percent, the average load would total 963 cases and transportation cost per case would be reduced from 70 to 63 cents per case.

When the added cost of palletized storage and transportation costs are included in the comparison of shipping systems, the slipsheet system with clamp loading at \$52.93 per load is the lowest cost system (table 5). Handstacked and pallet shipment are approximately the same at \$101.06 and \$98.10 per load, respectively.

**Table 5.—Cost with four methods of shipping groceries in trailers<sup>1</sup>**

Cost item	Method			
	Handstack	Pallet	Slipsheet push-pull loaded <sup>2</sup>	Slipsheet clamp-loaded <sup>3</sup>
-----Dollars per load-----				
Labor <sup>4</sup>	72.34	14.65	25.69	24.83
Equipment <sup>5</sup>	8.90	2.46	3.54	3.42
Materials <sup>6</sup>	—	25.80	10.00	10.00
Damage <sup>7</sup>	6.54	8.31	11.08	11.08
Dunnage <sup>8</sup>	—	3.60	3.60	3.60
Total direct cost	87.78	54.82	53.91	52.93
Added storage cost <sup>9</sup>	13.28	13.28	13.28	—
Added transportation cost <sup>10</sup>	—	30.00	—	—
Total indirect cost	13.28	43.28	13.28	—
Total shipping cost	101.06	98.10	67.19	52.93

<sup>1</sup>For details on labor productivity see appendix table 1.

<sup>2</sup>Based on forklift with a push-pull attachment for loading and unloading.

<sup>3</sup>Based on forklift with a clamp attachment for loading and push-pull for unloading.

<sup>4</sup>Labor costs are based on \$8.40 per hour including fringe benefits.

<sup>5</sup>Appendix table 2 shows determination of hourly equipment cost.

<sup>6</sup>Material costs for the pallet are shown in appendix table 3. Cost for the 44- by 52-inch slipsheet is assumed to be \$0.50.

<sup>7</sup>Based on an average case value of \$11.08.

<sup>8</sup>Based on two bands of 1/2-inch glasine tape per unit load at \$0.18.

<sup>9</sup>Added cost at supplier plant, see table 1.

<sup>10</sup>Based on 20 pallets at 75 pounds each, or 1,500 pounds at a tariff of \$2 per hundredweight.

It may not be possible to determine the savings at a given food distribution warehouse with use of slipsheet shipping because most of the savings will be realized by the supplier and carrier, and may or may not be passed on to the customer. In addition, the commodity mix and types of truckloads received will vary from one warehouse to another at any particular time. Less-than-trailerloads (LTL's) are not as likely to be slipsheeted as full trailerloads because LTL's have many less-than-full unit loads and are handled through terminals that do not have equipment for handling slipsheets. LTL's accounted for approximately 35 percent of the trucks received at four warehouses. Backhaul loads will likely remain palletized because freight costs are not critical and pallet exchange is not difficult.

Trailer-on-flatcar or piggyback trailerloads, which accounted for 20 percent of truck receipts at six warehouses (see footnote 4), do not have the potential transportation cost savings as over-the-road trucks, because piggyback loads are typically not palletized.

To determine the potential savings with slipsheet shipment, the average cost for the pallet system was \$98.10 per load (table 5) and for the handstacked system, \$101.06. The average cost for the two systems was \$99.58 per load. The cost for the slipsheet system using clamp loading was \$52.93, or an average savings of \$46.65 per load over the other two methods. Figure 4 shows the magnitude of these savings based on the number of trailerloads received by slipsheet each week as opposed to handstacked and pallet shipment.

To determine potential savings with slipsheet shipment, each firm should record the number of full truckload grocery receipts that are handstacked or palletized for a minimum of 4 weeks. The full truckload pallet and handstacked loads are potential candidates for slipsheet receiving. By using the chart shown in figure 4, projected system savings for slipsheet shipments to an individual firm can be determined.

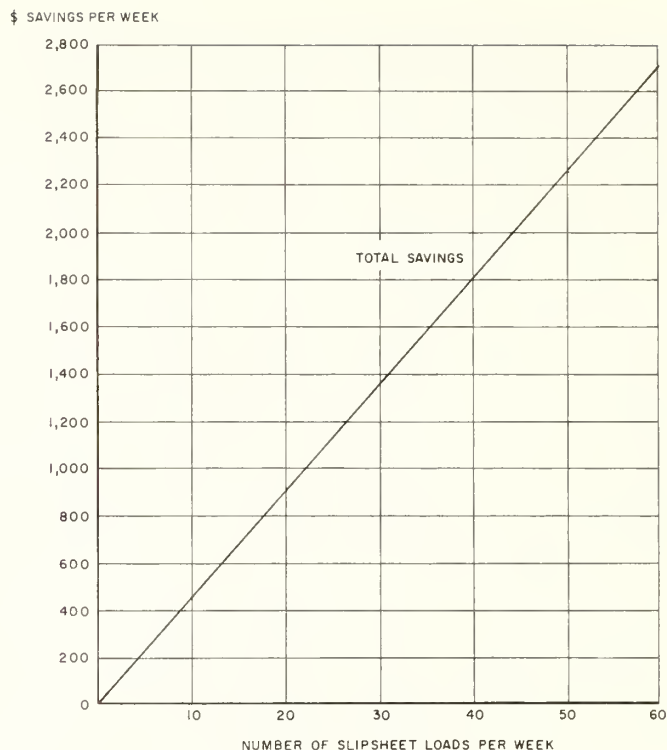


Figure 4.—Potential weekly savings for shipment of groceries from supplier to distribution warehouse on slipsheet by number of full trailer shipments.

The majority of suppliers shipping full trailerloads, including consolidation warehouses, have forklift trucks with either clamp or push-pull attachments and can load unitized on slipsheets, providing they know the receiver has the capability to unload slipsheet unit loads. Several wholesale receivers indicated there should be an adjustment in the prepaid cost of the product to compensate the receiving warehouse for unloading the trailer. Typically, truck drivers palletize groceries and remove unit loads from trailers with palletjacks. However, slipsheeted loads must be unloaded with a forklift truck having a push-pull attachment that warehouse managers indicated should be unloaded by trained warehouse personnel, thus adding cost to warehouse receiving.

**Table 6.—Warehouse costs at the dock for unloading trailers with product palletized, handstacked, and slipsheeted**

Cost item	Method					
	Palletized		Handstacked		Slipsheeted	
	Hours	Dollars	Hours	Dollars	Hours	Dollars
Labor <sup>1</sup>	0.72	6.05	0.82	6.89	1.07	8.99
Equipment <sup>2</sup>	.72	1.51	.82	1.72	1.07	2.48
Space <sup>3</sup>	.72	.43	3.90	2.34	1.07	.64
Total	—	7.99	—	10.95	—	12.11

<sup>1</sup>Labor requirements based on warehouse forklift operator time for removing unit loads from the trailer as shown in table 24, MRR-1075 for palletized unloading (0.0328 worker-minute per case), and appendix table 6 in this report for slipsheeted unloading. More forklift operator time is required to unload product palletized in the truck by the driver due to waiting for palletization.

<sup>2</sup>Estimated equipment costs are shown in appendix table 2.

<sup>3</sup>Based on unloading dock area of 480 square feet per trailer, \$3 per square foot annual occupancy cost or \$0.60 per hour.

### Warehouse Unloading Costs

Total system costs, as measured in this study, are lower for slipsheet shipment than for palletized and manual methods. However, the warehouse manager is concerned about costs associated with unloading trailers at the warehouse.

To provide a valid comparison of warehouse costs related to unloading trucks with three methods—manual, pallet, and slipsheet—it is necessary to establish similar methods for comparison. Therefore, the following methods are used in the comparison: (1) All defective pallets are rejected at the receiving dock, thus eliminating pallet repair costs; (2) a warehouse forklift operator removes all loaded pallets from the trailer, whether manually palletized at the warehouse or loaded on pallets at origin; (3) the forklift operator also serves as the receiver and maintains the receiving records; (4) push-pull and regular forklifts will be used 12 hours per day; (5) unusual forklift-delay time is excluded from the comparison; and (6) the push-pull forklift also will be used to unload palletized loads. As shown in table 6, the warehouse unloading costs per trailer total \$7.99 for palletized products, \$10.95 for handstacked products, and \$12.11 for slipsheeted products.

Table 6 clearly shows increased costs to the warehouse receiver for slipsheeted loads. Additional costs to the warehouse for unloading slipsheeted loads total \$4.12 per load when compared with pallets and \$1.16 when compared with handstacked. Each warehouse manager should consider the alternative unloading costs, examine receiving methods at the warehouse, look at the trend in slipsheet shipments, and decide whether to purchase the equipment for slipsheet unloading.

## Observations

Most food distribution warehouses use a forklift truck with a push-pull attachment for receiving grocery products at the rail dock. Personnel at the truck dock may request its use for unloading a slipsheet trailer, and typically they will have to wait until the equipment is available, or they will unload the trailer by hand. The push-pull forklift used at the rail dock is frequently too heavy and/or has a mast that is too high for entering many trailers. Few wholesale distribution warehouse truck-receiving docks have their own push-pull forklift trucks; therefore, shippers are not encouraged to ship unitized grocery products on slipsheets.

Many materials-handling equipment suppliers have the smaller 2,500- and 3,000-pound capacity forklift trucks with push-pull attachments that can enter over-the-road trailers for unloading. Figure 5 shows the type of forklift used to unload slipsheet shipments at the truck dock. In addition, such forklifts with a divided platen or base can also serve as a conventional low-lift fork for double-stacking pallets on the dock for later storage by conventional forklift trucks.

Other available equipment includes a walkie-rider type electric palletjack with a push-pull attachment available at about half the cost of the 3,000-pound forklift truck with a similar attachment. The walkie-rider weighs less and the operator can adjust slipsheet tabs, as needed, more easily than is possible with counter-balanced trucks. There also is a standup-rider forklift with a push-pull attachment that can be used to unload trailers.

Currently, smaller push-pull equipment is not being used for two principal reasons: (1) Few trailers loaded unitized on slipsheets are received at grocery warehouses; and (2) the smaller walkie-rider and standup-rider forklift with push-pull attachments are special types of equipment that can only handle slipsheets.

The clamp loading of product on slipsheets is a lower cost system than push-pull loading, but the clamp is not suitable for unloading. If there were a method of holding unit loads in place in the trailer, shipments of unit loads without a platform would be possible. However, this would also necessitate having a clamp-forklift truck at the receiving warehouse.



Figure 5.—A forklift truck with a push-pull attachment used to unload trailers having unitized slipsheet loads.

To obtain full benefit with slipsheet shipment it is essential that loads be properly secured. The taping of the top two layers of cases in each unit load will usually keep the unit load intact. The shipment of shrink-wrapped cases on slipsheets has several advantages over taping the top two layers, including: (1) No additional dunnage is required to keep unit loads intact; (2) the unit loads are easy to load and unload; (3) shrink wrap is used to package tray-pack cases with savings in corrugated fiberboard usually sufficient to offset the cost of the shrink film; (4) there is reduced damage in shipping; (5) there is no loss of weight or cubic space; (6) nearly all groceries, other than bagged items, can be stored without pallets and clamp loaded in the supplier plant which reduces storage cost; and (7) labor savings are accomplished with tray-pack cases in retail stores.<sup>7</sup>

<sup>7</sup>Greene, A. and P. F. Shaffer. Tray pack speeds up shelf stacking in grocery stores. AMS, U.S. Dept. Agr., Marketing, Vol. 5, No. 5, 16 pp. 1960.

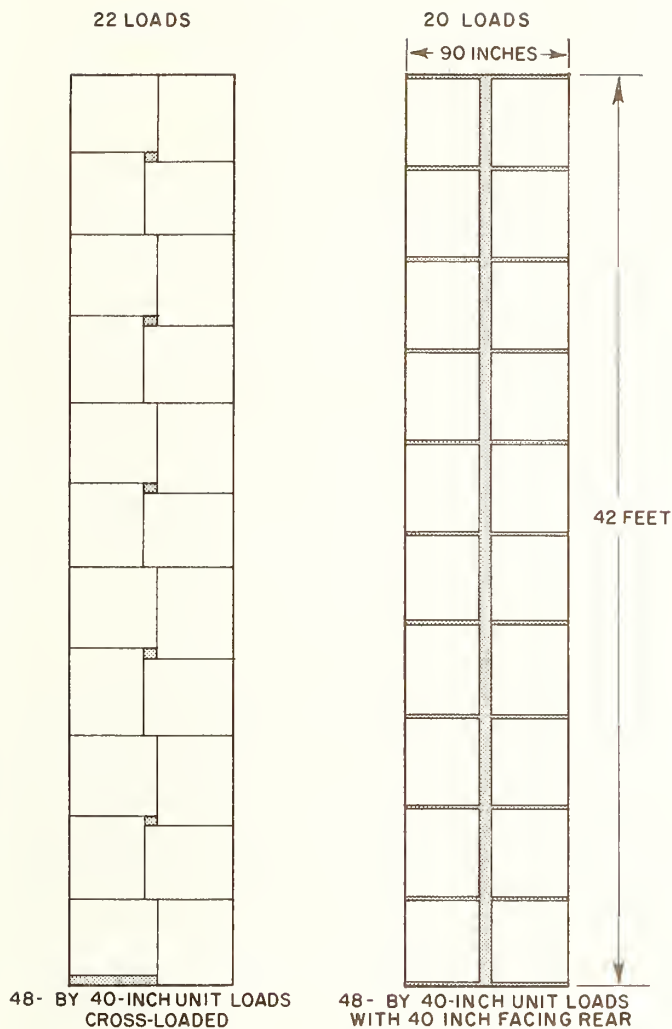


Figure 6.—Trailer-loading pattern for cross-loading and straight loading of 48- by 40-inch unit loads.

To maximize use of available cubic space in a trailer, it is possible to place every other unit load crossed, that is, the 48-inch side rather than the 40-inch side faced to the rear of the trailer. (See fig. 6.)

Twenty unit loads can be placed on the floor of a 42-foot trailer when it is loaded with the 40-inch side of each unit load facing the rear; by cross-loading, 22 unit loads can be placed on the floor, an increase of 10 percent in space utilization. However, such loads, called pinwheelled, must be unloaded with a forklift truck because pallet jacks cannot get under the openings.

All firms involved in the shipment of groceries by truck should consider the total product-distribution system rather than only that portion of the system in which they are involved. The distribution system includes supplier plant managers, trucking company executives, individual truck owners, warehouse managers, retailers, and to some extent, equipment manufacturers.

Grocery suppliers would probably like to ship product on slipsheets, but very few grocery distribution houses now have a forklift truck with push-pull attachment available to unload trailers. Truckers may prefer slipsheets so they can carry more revenue-producing freight, but on most slipsheet shipments they must unload the product manually when unloading equipment is not available at the warehouse. Arrangements need to be made between suppliers and receivers of potential slipsheet loads concerning needed forklift truck with push-pull attachments and forms of compensation for added warehouse dock labor and equipment.

All parts of the distribution system will gain with the slipsheet system. The supplier plant will no longer have the burden of pallet exchange and repair and will realize the economies of palletless storage and handling for most items. The carrier will not have added cost because of the pallet weight, loss of cubic space, or returning pallets. Further efficiencies may result from increased backhaul opportunities. The distribution warehouse manager will find unitized unloading more productive because there is less waiting time for trailers at receiving doors than when loads are hand-stacked.

From an industry overview, potential savings with unitized slipsheet shipment of groceries, clamp loading, and push-pull unloading total \$48.13 per trailerload compared with handstacking and \$45.17 compared with palletized shipping (table 5). A conservatively estimated 3.4 million trailer loads of groceries are shipped from suppliers to wholesale distribution warehouses annually. Based on savings of \$45.17 per trailerload, industry savings of more than \$160 million annually can be achieved in the marketing system with unitized slipsheet shipment of groceries (appendix table 7). One method that can be used to encourage more unitized shipment of groceries on slipsheets is to transfer part of the unloading allowance, now included in the tariff, from the carrier to the warehouse receiver who will unload the groceries. Slipsheets provide an opportunity for all firms involved in grocery distribution to benefit by recognizing their mutual problems and cooperating to develop an improved system of grocery shipment.

## Appendix

**Appendix table 1.—Labor productivity with four methods of shipping groceries in trailers**

Method	Loading	Unloading	Total
<i>Worker-hours per load<sup>1</sup></i>			
Handstack	3.117	5.495	8.612
Pallet	.590	1.153	1.743
Slipsheet—push-pull <sup>2</sup>	.920	2.138	3.058
Slipsheet—clamp <sup>3</sup>	.819	2.138	2.957
<i>Cases per worker-hour</i>			
Handstack	423	240	153
Pallet	2237	1145	757
Slipsheet—push-pull	1435	617	432
Slipsheet—clamp	1612	617	446

<sup>1</sup>Based on 1,320 cases per load.

<sup>2</sup>Based on forklift truck with a push-pull attachment for loading and unloading.

<sup>3</sup>Based on forklift truck with a clamp attachment for loading and push-pull attachment for unloading.

**Appendix table 2.—Estimated cost of ownership and operation for various types of materials-handling equipment used in loading and unloading grocery products in trailers**

Type of equipment	Initial cost <sup>1</sup>	Salvage value <sup>2</sup>	Annual depreciation <sup>2</sup>	Annual interest <sup>3</sup>	Total annual fixed cost	Annual operating cost <sup>2</sup>	Total annual cost	Average life	Annual use	Average cost per hour <sup>4</sup>
	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Years</i>	<i>Hours</i>	<i>Dollars</i>
Electric palletjack; (2,500-lb capacity)	6,000	500	1,100	300	1,400	1,924	3,324	5	2,960	1.12
Electric low-lift, counter-balanced forklift truck (4,000-lb capacity)	16,500	1,500	2,500	825	3,325	2,992	6,317	6	3,000	2.10
Electric forklift with push-pull attachment (3,000-lb capacity)	24,000	2,500	3,583	1,200	4,783	2,184	6,967	6	3,000	2.32
Electric forklift with clamp attachment (5,000-lb capacity)	25,000	2,600	3,725	1,250	4,975	4,200	9,175	6	4,000 <sup>5</sup>	2.29

<sup>1</sup>From equipment manufacturers, including battery.

<sup>2</sup>From cooperating firms' internal records.

<sup>3</sup>Purchase cost divided by 2 equals average investment times interest at 10 percent equals average interest cost.

<sup>4</sup>Total annual cost divided by annual hourly usage.

<sup>5</sup>Equipment used for two shifts each day.

**Appendix table 3.—Estimated pallet cost per trip or month for truck shipment of groceries**

Element <sup>1</sup>	Cost
	<i>Dollars</i>
Interest <sup>2</sup>	703
Depreciation cost <sup>3</sup>	4,688
Monthly pallet loss and discard 500 @ \$7.50	3,750
Repair—200 @ \$2.50	500
Total monthly cost	9,641
Pallet cost per trip	1.29

<sup>1</sup>Basic assumptions are based on data obtained from four supplier firms and include: average pallet cost—\$7.50; 7,500 unit loads shipped monthly on pallets of which 300 are lost in the system, 200 are discarded, and 200 are repaired. Average pallet inventory is 22,500. Interest cost is 10 percent annually.

<sup>2</sup>Average inventory (22,500 pallets) times cost (\$7.50), divided by 2 times 10 percent divided by 12 months.

<sup>3</sup>Purchase of 22,500 pallets at \$7.50 divided by 36 months' use.

**Appendix table 4.—Production standard for loading trailers with groceries on slipsheets using a forklift with clamp attachment**

Element description	Basic elemental time	Frequency of occurrence	Weighted elemental time
	<i>Worker-minutes</i>	<i>Percent</i>	<i>Worker-minutes</i>
Engage load with clamp	0.226	100.0	0.226
Travel into trailer	.272	100.0	.272
Drop unit load on slipsheet	.236	100.0	.236
Return to dock	.218	100.0	.218
Place dock plate	.887	2.1	.019
Planning	.160	.4	.001
Turn unit load 90 degrees	1.042	2.2	.023
Check invoice	.255	2.1	.005
Rearrange cases	.193	.5	.001
Move empty pallets	3.330	.7	.023
Handle damaged case	1.440	.4	.006
Straighten unit load	.391	9.8	.038
Total forklift operator worker-minutes per unit load			1.068
15 percent personal and fatigue allowance			.160
Standard forklift operator worker-minutes per unit load			1.228
Standard worker-minutes for helper			1.228
Standard worker-minutes per unit load			2.456
Standard unit loads per hour			48.9
Standard unit loads per worker-hour			24.4
Standard worker-minute per case <sup>1</sup>			.037
Standard worker-minutes per load <sup>2</sup>			49.1

<sup>1</sup>Based on 66 cases per unit load.

<sup>2</sup>Trailerload based on 20 unit loads or 1,320 cases.

**Appendix table 5.—Production standard for loading trailers with groceries on slipsheets using a forklift with push-pull attachment**

Element description	Basic elemental time	Frequency of occurrence	Weighted elemental time
	<i>Worker-minutes</i>	<i>Percent</i>	<i>Worker-minutes</i>
Engage load	0.244	100.0	0.244
Travel to trailer	.173	100.0	.173
Travel into trailer	.224	100.0	.224
Push off unit load	.172	100.0	.172
Travel out of trailer	.144	100.0	.144
Return to dock	.152	100.0	.152
Place dock plate	.887	2.1	.019
Planning	.160	.4	.001
Turn unit load 90 degrees	1.042	2.2	.023
Check invoice	.255	2.1	.005
Rearrange cases	.193	.5	.001
Move empty pallets	3.330	.7	.023
Handle damaged case	1.440	.4	.008
Double-up unit loads	1.100	.9	.010
Total forklift operator worker-minutes per unit load			1.199
15 percent personal and fatigue allowance			.180
Standard forklift operator worker-minutes per unit load			1.379
Standard worker-minutes for helper			1.379
Standard worker-minutes per unit load			2.758
Standard unit loads per hour			43.5
Standard unit loads per worker-hour			21.8
Standard worker-minute per case <sup>1</sup>			0.042
Standard worker-minutes per load <sup>2</sup>			55.2

<sup>1</sup>Based on 66 cases per unit load.

<sup>2</sup>Trailerload based on 20 unit loads or 1,320 cases.

Appendix table 6.—Production standard for slipsheet unloading of grocery trailers

Element description	Basic elemental time	Frequency of occurrence	Weighted elemental time
	<i>Worker-minutes</i>	<i>Percent</i>	<i>Worker-minutes</i>
Travel into trailer and engage	0.420	100.0	0.420
Travel to dock	.314	100.0	.314
Transfer slipsheet to pallet	.374	100.0	.374
Check product and tag	.439	120.6	.529
Travel to staging area	.303	123.0	.373
Drop unit load on dock	.270	27.8	.075
Rearrange cases on load	.689	6.4	.044
Handstack unload	3.298	3.6	.119
Prepare tags	3.217	1.6	.051
Process damage	4.767	1.2	.057
Remove tape	.605	1.6	.010
Obtain empty pallets	.980	11.9	.117
Set aside full load	.863	4.0	.035
Reverse pallet position	.933	2.4	.022
Separate unit loads	.705	1.6	.011
Remove bad pallet	.920	1.2	.011
Check load	.720	.4	.003
Check invoices	3.131	5.2	.163
Delays	1.020	5.6	.057
Clean	.545	.8	.004
Total forklift operation worker-minutes per slipsheet unit			2.789
15 percent personal and fatigue allowance			.418
Standard forklift operator worker-minutes per slipsheet unit			3.207
Standard worker-minutes for truck driver			3.207
Standard worker-minutes per slipsheet unit load			6.414
Standard unit loads per hour			18.7
Standard unit loads per worker-hour			9.4
Standard worker-minute per case <sup>1</sup>			0.0972
Standard worker-minutes per load <sup>2</sup>			128.3

<sup>1</sup>Number of cases per unit load—66.

<sup>2</sup>20 unit loads or 1,320 cases.

Appendix table 7.—Computation of annual potential industry savings with slipsheet shipment of groceries in trucks from supplier to wholesale warehouse

Item	Amount	Cases	Trailers
	<i>Million dollars</i>	<i>Billions</i>	<i>Millions</i>
1979 retail foodstore sales <sup>1</sup>	199,400.0	—	—
Grocery sales in foodstores <sup>2</sup>	133,600.0	—	—
Estimated 75 percent of grocery sales warehouse-delivered <sup>3</sup>	100,198.0	—	—
Estimated 60 percent of groceries delivered to warehouse by common-carrier truck <sup>4</sup>	60,119.0	—	—
Estimated grocery retail case value \$13.00 equals	—	4.6	—
Average trailerload of 1,320 cases equals	—	—	3.5
Potential annual savings based on \$45.17 per trailerload <sup>5</sup>	162.6	—	—

<sup>1</sup>Progressive Grocer, Vol. 59, No. 4, April 1980.

<sup>2</sup>Supermarket News, Vol. 29, No. 3, July 23, 1979. NARGUS Survey of Supermarkets indicating 67 percent of store sales were grocery and bakery.

<sup>3</sup>Estimated retail sales of direct store deliveries of grocery and bakery items, 25 percent, and warehouse-delivered 75 percent of sales.

<sup>4</sup>Bouma, J. C. Truck unloading of manufacturer shipments at grocery distribution warehouses. ARS-NE-68, U.S. Dept. Agr., 23 pp. 1976.

<sup>5</sup>Based on \$45.17 savings per trailerload for clamp loading and slipsheet shipment compared with pallet shipment. Savings are \$48.13 per trailerload when compared with handstack loading and unloading.



United States  
Department of Agriculture  
Washington, DC 20250

OFFICIAL BUSINESS

Penalty for private use, \$300

Postage and Fees Paid  
U.S. Department of Agriculture  
AGR-101

THIRD CLASS MAIL

